Measuring Treasury Debt and Market Depth

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The Basics

- US fiscal debt has come back into sharp focus recently
  - COVID-19
  - Industrial policy
  - Inflation
  - Rising interest rates
- Traditional view of the UST market focuses on size, not depth

- **Contributions**
  1. Simple sum of USTs is incorrect
  2. Derivation of user cost of USTs
  3. Creation of index to track quantity, monetary services aggregates
  4. Monetary services of USTs directly adds to fiscal sustainability

USTs are Imperfect Substitutes

Literature

- Krishnamurthy and Vissing-Jorgensen (2012, 2013)
- Nagel (2016)

  ⋮

- All: the various maturities/types of USTs have different attributes/purposes

Findings

- Extension of Amihud and Mendelson (1991)
  - Match securities that mature within one day of each other
  - Regress YTM spreads against a variety of factors
- **Contribution**
  - Bills are a liquidity hedge
  - Bonds are a savings vehicle
  - They should not be linearly aggregated

Details

The User Cost of Treasury Securities

- A proper index number
  - Not the aggregate, itself
  - Tracks the aggregate nonparmetrically
  - Must be derived from optimization
- Standard single-period user cost

$$\eta_t = \frac{R_t - r_t}{1 + R_t}$$

  - Barnett (1978)
  - Opportunity cost of holding the asset
- Partial equilibrium model: household
  - Standard utility maximization
  - Short- and long-term bonds, and a benchmark asset
- **Contribution**
  - Deriving the single-period user cost of a long-term asset

Details

The User Cost of Long-Term Treasury Securities

$$\eta_t^L = \frac{\mathbb{E}_t\left[\frac{\mu_{t+1}}{\mu_t}\frac{1}{\pi_{t+1}}\left\{R_t^n - \overbrace{(1-\delta)\gamma_{3,t+1}\Delta R_{t+1}^n}^{\text{one-period return, benchmark}} - \overbrace{\left(r_t^{L,n} - (1-\alpha)\gamma_{4,t+1}\Delta r_{t+1}^{L,n}\right)}^{\text{long-term bond}}\right\}\right]}{\mathbb{E}_t\left[\frac{\mu_{t+1}}{\mu_t}\frac{1}{\pi_{t+1}}\left\{1 + R_t^n - (1-\delta)\gamma_{3,t+1}\Delta R_{t+1}^n\right\}\right]}$$

- $R_t^n, r_t^{L,n}$ are "coupon" rates
- $\gamma_{i,t+1}$ is the expected price

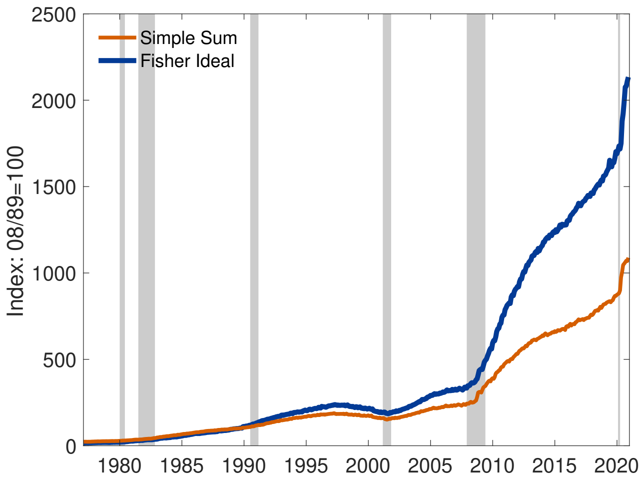
$\Big\}$ $\gamma_{3,t+1}\Delta R_{t+1}^n$ is the expected capital gain

- $\delta, \alpha \in (0,1]$ are the maturity rates

Data and Baseline Result

- Center for Research in Securities Pricing (CRSP)
- CUSIP-level, monthly data on US Treasuries: 1977-2020
- 1-month ahead forward rates used for expected values
- Fisher-ideal index functional form
  - Securities separated by type
  - Then separated by quarters to maturity

Initial Results

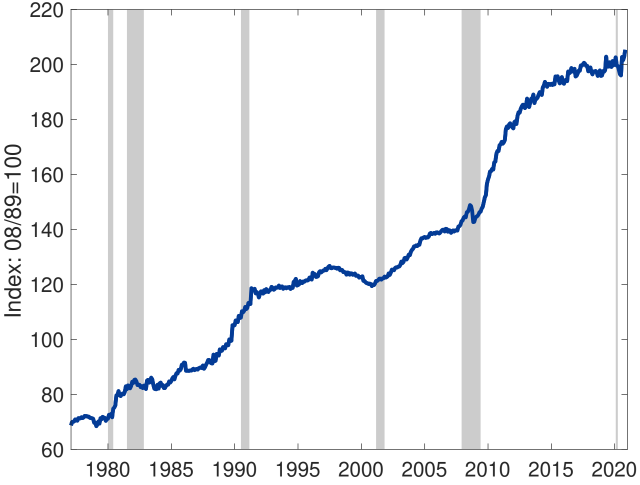


Extracting the Monetary Services of Treasury Securities

$$\%\Delta(\text{Quantity} + \text{Monetary Services})$$

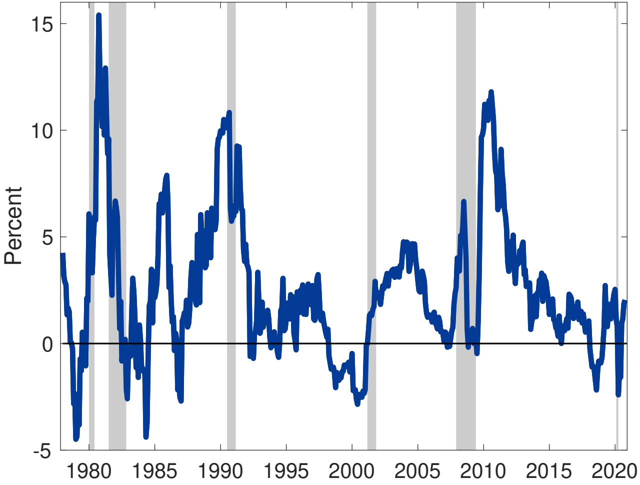
$$-\%\Delta(\text{Quantity})$$

$$= \%\Delta(\text{Monetary Services})$$



It's all Relative

- This index is a measure of the "depth" of the market
- More recent movements align with
  - Budget surpluses of the 1990s
  - European debt crisis of the 2010s
  - COVID-19 "dash for cash"



The Value of Treasury Securities

- Traditional accounting of fiscal capacity relies on the simple sum of USTs
- The analysis here shows that this is incorrect
- USTs provide a monetary service to the economy

- Brunnermeier, Merkel and Sannikov (2022)-like analysis
- **Contribution**
  - The value of USTs directly contributes to fiscal sustainability
  - Also see the tradeoffs faced when considering a portfolio of USTs with varying maturities

Fiscal Capacity and the Value of USTs

Spread Component

Primary surplus

$$\frac{B_{t-1}+B^L_{t-1}}{p_t}(1+r_{t-1}) = \underset{\uparrow\,\text{Primary surplus}}{s_t} - \underbrace{(r^L_{t-1}-r_{t-1})\frac{B^L_{t-1}}{p_t}}_{\text{Spread Component}} + \beta\mathbb{E}_t\left[\frac{\mu_{1,t+1}}{\mu_{1,t}}\frac{B_t+B^L_t}{p_{t+1}}(1+r_t)\right]$$

$$+\beta\mathbb{E}_t\left[\frac{\mu_{1,t+1}}{\mu_{1,t}}\frac{B^L_t}{p_{t+1}}(1+r^L_t-(1-\alpha)\gamma_{4,t+1}\Delta r^{L,n}_{t+1}-r_t)\right]+\gamma_{2,t}\frac{M_t}{p_t}$$

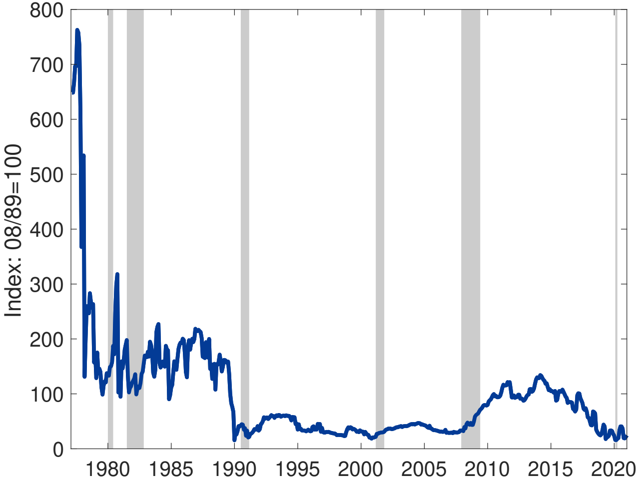
Relative Holding-Period Return

Value of Monetary Services

- M_t is stock of monetary services
- $\gamma_{2,t}$ is the price dual of those monetary services
- Thus, the value of these monetary services directly adds to fiscal capacity

The Value of these Monetary Services

- Price dual via Fisher's factor reversal
- Further exploration of this is needed
  - Fiscal sustainability
  - Inflation
  - Monetary policy



Conclusion

- **Contributions**
  1. Simple sum of USTs is incorrect
  2. Derivation of user cost of USTs
  3. Creation of index to track true aggregate
  4. Value of USTs directly impacts fiscal sustainability
- USTs are more than just the sum of their principal value

- **Extensions**
  - Applications to sovereign debt crises
  - Expansion of the measure to include risk
  - Refining the basket of securities
  - Monetary-Fiscal interaction and inflation

Thank You!

Questions?

Appendix Slides

Bond Market Segmentation: Model

- Data
  - USTs: separated by nominal type
  - Oct 1996–Dec 2020 subsample
- Methodology
  - Matching by days to maturity
  - Bill matches: 6 months maturity or less
  - Dependent variable: YTM spread

$$\text{spread: ``senior''} - \text{``junior''}$$

- Independent Variables
  1. Relative bid-ask spread

$$\frac{\text{ask price} - \text{bid price}}{\text{ask price} + \text{accrued interest}} \times 100.$$

  2. Coupon rate spread
  3. Months/years to maturity
  4. 10y-2y spread
  5. Constant

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	Notes–Bills	Bonds–Notes	Bonds–Bills
Relative Bid-Ask Spread	0.4163**	0.0981	−0.1424**
	(0.173)	(0.074)	(0.074)
Coupon Rate Spread	0.0210***	0.0170***	0.0076
	(0.001)	(0.005)	(0.013)
10y-2y Spread	0.0234***	−0.0124***	−0.0484
	(0.003)	(0.002)	(0.033)
⋮	⋮	⋮	⋮
Observations	2250	7430	78
R-Squared	0.207	0.505	0.399
F-statistic	99.48	207.2	20.19

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Bonds in the Utility Function

- Analysis of USTs is relative to USTs only
  - Bonds are still liquid overall
  - Bills are still safe overall
  - Modeling this way avoids larger assumptions
- Simple frictions to capture liquidity, etc. can be represented in a money-in-the-utility setting
- Use of MB = MC
  - Left side: parametarized assumptions
  - Right side: equivalent, nonparametric form

$$\max \mathbb{E}_t \sum_{t=0}^{\infty} \beta^t \{u(c_t) + v(m_t) + x(1 - l_t)\}$$

- m_t: monetary services $\sim$ second-order translog function
  1. an exact aggregator function
  2. second-order Taylor approximation of unknown aggregator
  3. second-order approximation to a CES function

(Boisvert, 1982)

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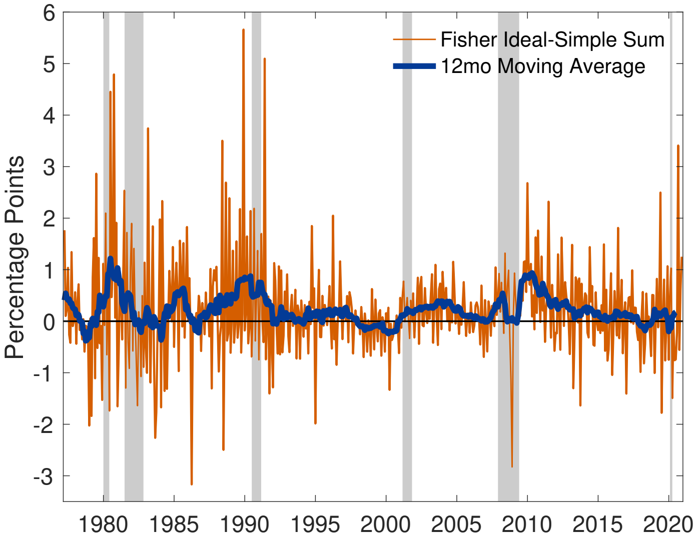
Initial, Monthly Results



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